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(54) SONIC WATER LEVEL METER AND SONIC FLOWMETER

(57)Abstract:

PURPOSE: To achieve higher detection accuracy of a water level meter and a flowmeter by setting a sound wave transducer at the upper end of a spiral sonic tube with an open lower end of the sonic tube positioned below a water level to be detected to expand a change in the actual water level apparently.

CONSTITUTION: Water is injected into a container 11 from a water injection pipe 14 while flowing out at outflow ports 15a-15d so that water is retained in the container 11 by an amount equivalent to a difference between an injection quantity and an outflow quantity of the water. The water also flows into a spiral sonic tube 17 to the same height as that of water level. Under such a condition, when a sound wave transducer 13 is driven to emit a sound wave into a sonic tube 17 from a measuring device 21, the sound wave travels through the sonic tube 17 along the spiral thereof and is reflected on the surface 22 of the water therein to be returned to the sound wave transducer 13. The measuring device 21 computes the length of a path of the sound wave based on a delayed time to the arrival of the reflected wave from the time of the emission of the sound wave and furthermore, a flow rate is computed based on the depth H of the water at the outflow ports 15a-15d and opening areas of the outflow ports 15a-15d.
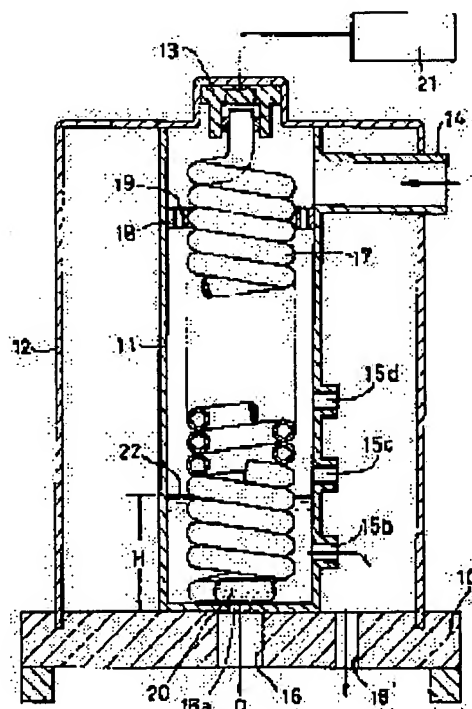
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CLAIMS

[Claim(s)]
[Claim 1] The acoustic wave water gauge characterized by to make it caudad located from the water surface which should install an acoustic wave transducer in the predetermined height on the water surface, should install the above-mentioned acoustic wave transducer in the upper limit of spiral-like acoustic wave tubing in the water gauge which detected water level based on the time delay until the acoustic wave discharged towards the water surface reflects and returns on the above-mentioned water surface, and should detect the open lower limit of this spiral-like acoustic wave tubing.
[Claim 2] While preparing a filling port in a container, a tap hole is established in a location lower than this filling port. Install an acoustic wave transducer in the location of the predetermined height on the water surface of the above-mentioned container, and water level is detected based on a time delay until the acoustic wave discharged towards the water surface reflects and returns on the water surface. The acoustic wave flowmeter characterized by having installed the above-mentioned acoustic wave transducer in the upper limit of spiral-like acoustic wave tubing, and inserting the open lower limit of this spiral-like acoustic wave tubing into the above-mentioned container in the flowmeter which detected the outflow discharge based on the cross section of the water level and above-mentioned tap hole.
[Claim 3] The acoustic wave flowmeter according to claim 2 characterized by preparing two or more tap holes in the shape of multistage.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] Invention concerning this application relates to the water gauge and flowmeter which used the acoustic wave.
[0002]
[Description of the Prior Art] An acoustic wave transducer is installed in the location of the predetermined height on the water surface which should detect water level, a time delay until the acoustic wave reflected towards the water surface reflects and returns on the water surface is measured, and the water gauge which detected water level based on the time delay is known from the former.
[0003] Moreover, in order to detect the flow rate which flows out of the tap hole of containers, such as a tank, the above-mentioned water gauge is used and the principle of the flowmeter which detects a flow rate based on the water level detected by this is also known from the former. Drawing 1 inserts the lower limit section of the acoustic wave tubing 5 in a location lower than the water surface 6 while it is the principle Fig. of the flowmeter, and establishing a filling port 2 in the upper part of a container 1, establishing a tap hole 3 in the lower part, and it installing the acoustic wave transducer 4 in the upper limit of the acoustic wave tubing 5 of both-ends disconnection and making it this acoustic wave transducer 5 located in the predetermined height on the water surface 6.
[0004] In this case, height HT from the tap hole 3 to the acoustic wave transducer 4 It is known and the cross section S of a tap hole 3 is known. If a time delay until the acoustic wave discharged towards the water surface 6 returns from the acoustic wave transducer 4 is measured with a suitable measuring instrument, it is the height HS from the water surface 6 to the acoustic wave transducer 4. It can know. furthermore, the aforementioned HT HS from -- depth of water H can be known.
[0005] Between depth of water H and outflow flow Q, it is [0006] by Torricelli's principle.
[Equation 1]
$$Q = S \sqrt{2 g H} \qquad （但し、 g は重力の加速度）$$

[0007] Since it is known that there is ******, thereby, flow Q can be known.
[0008]
[Problem(s) to be Solved by the Invention] In the acoustic wave water gauge or acoustic wave flowmeter like the above, an operation means to convert the time delay of an acoustic wave into distance is needed. When this operation means carries out the multiplier of the number of the pulses of the unit time interval within a time delay, means to convert a time delay into distance are taken.
[0009] Although spacing of the pulse in this case is set as suitable spacing based on the die length and acoustic velocity of a path of an acoustic wave, that spacing has the precision bound of a pulse generator, and cannot be made fine more than that limit. That is, it is as the same as a fixed limit is in spacing of the minimum scale of a ruler. For this reason, the demand of wanting to raise the precision of detection of at least water further cannot be met.
[0010] Then, without changing the aforementioned pulse separation, this invention makes it a technical

problem to raise the detection precision of a water gauge and a flowmeter, when at least actual water expands change seemingly.

[0011]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem invention according to claim 1 In the water gauge which detected water level based on the time delay until the acoustic wave which installed the acoustic wave transducer in the predetermined height on the water surface, and was discharged towards the water surface reflects and returns on the above-mentioned water surface The above-mentioned acoustic wave transducer is installed in the upper limit of spiral-like acoustic wave tubing, and it considers as the configuration you made it caudad located from the water surface which should detect the open lower limit of this spiral-like acoustic wave tubing.

[0012] Moreover, invention according to claim 2 establishes a tap hole in a location lower than this filling port while preparing a filling port in a container. Install an acoustic wave transducer in the location of the predetermined height on the water surface of the above-mentioned container, and water level is detected based on a time delay until the acoustic wave discharged towards the water surface reflects and returns on the water surface. In the flowmeter which detected the outflow discharge based on the cross section of the water level and above-mentioned tap hole, the above-mentioned acoustic wave transducer is installed in the upper limit of spiral-like acoustic wave tubing, and it considers as the configuration which inserted the open lower limit of this spiral-like acoustic wave tubing into the above-mentioned container.

[0013] Invention according to claim 3 is taken as the configuration which prepared two or more tap holes in the shape of multistage in the above-mentioned flowmeter.

[0014]

[Function] As shown in drawing 2 (a), spiral-like acoustic wave tubing can regard direct-like acoustic wave tubing as having leaned at the fixed include angle theta, and it is the die length $l1$ in direct-like acoustic wave tubing. With spiral-like acoustic wave tubing, it is $l2$. It is expanded. Since it is $l2 = l1 /$ sintheta, it is the dilation ratio $l1 / l2$. It is set to 1-/sintheta.

[0015] Since the migration length of water of the water to which it becomes like drawing 2 (b) and at least the water in a container moves the inside of acoustic wave tubing with change corresponds with change in the case of direct-like acoustic wave tubing, but it will move according to the aisleway in the case of spiral-like acoustic wave tubing if ****** and the coil at the time of setting a dilation ratio to 10 are shown by comparison, the migration length becomes long by the aforementioned dilation ratio. Moreover, the direction of spiral-like acoustic wave tubing becomes long by the aforementioned dilation ratio similarly about the passage distance of an acoustic wave. That is, it can be said that spiral-like acoustic wave tubing has the operation to which the migration length of water and the passage distance of an acoustic wave are expanded compared with direct-like acoustic wave tubing.

[0016] Therefore, since at least water can be expanded seemingly and can catch change by using spiral-like acoustic wave tubing, detection precision will improve.

[0017]

[Example] Drawing 3 is the example of a flowmeter. This flowmeter inserts an outer container 12 in the surroundings of the contents machine 11 installed on the pedestal 10, and is fixing the lower limit of that outer container 12 to a pedestal 10. The upper limit center section of the outer container 10 is equipped with the acoustic wave transducer 13. An audible-sound wave or a supersonic wave is sufficient as the acoustic wave in this case.

[0018] A hose 14 is fixed to the upper limit section side face of the contents machine 11. This hose 14 penetrates an outer container 12, and is beginning to be prolonged outside. Two or more steps of tap holes 15a, 15b, and 15c and height spacing with fixed 15d are set in the base and side face of the contents machine 11, and it is prepared in them. Even if these cross sections are the same, and they differ, respectively, they do not interfere. Moreover, the exhaust port 16 for discharging to the exterior the water which came out from the above-mentioned tap holes 15a-15d, and 16' are prepared in a pedestal 10.

[0019] The spiral-like acoustic wave tubing 17 of the die length covering the vertical both ends is

formed in the interior of the contents machine 11, and the inner skin of the contents machine 11 is made to support a part of the acoustic wave tubing 17 with a retaining ring 18 in the part near a hose 14. Form many holes 19 in this retaining ring 18, and he makes the water which flowed from the hose 14 distribute, and is trying to make it fall equally.

[0020] The vertical both ends of the spiral-like acoustic wave tubing 17 are opened wide, equip with the strainer 20 which becomes the lower limit from a porous material, and ease the flow of the water which goes in and out in the acoustic wave tubing 17, and he is trying to maintain the water surface in the acoustic wave tubing 17 at a quiescence side. The aforementioned acoustic wave transducer 13 is faced the upper limit of the acoustic wave tubing 17. The acoustic wave echo sounder transmitter 13 is electrically connected to the external metering device 21.

[0021] In addition, the magnitude of the tilt angle theta of the above-mentioned spiral-like acoustic wave tubing 17 (refer to drawing 2 (a)) is suitably determined according to a dilation ratio.

[0022] The above-mentioned metering device 21 carries out counting of the pulse number generated with an internal pulse generator in the time delay of an acoustic wave, and has record of the means and the result of an operation which calculate distance based on the enumerated data, a display means, etc. while it drives the acoustic wave transducer 13.

[0023] More than unties the flowmeter of an example, and it is a thing, pours in water into the contents machine 11 from a hose 14, and is made to flow into coincidence out of tap holes 15a-15d, and only the part of the difference of an injection rate and a flow makes water stay in the contents machine 11. Water flows also into the interior of the spiral-like acoustic wave tubing 17 to the same height as the water level. In this condition, the acoustic wave transducer 13 is made to drive from a metering device 21, and an acoustic wave is turned in the acoustic wave tubing 17, and it discharges. The inside of the acoustic wave tubing 17 is progressed along with the spiral, it is reflected on the water surface 22 of the interior, and an acoustic wave returns to the acoustic wave transducer 13.

[0024] In a metering device 21, based on the time delay from the discharge point in time of the above-mentioned acoustic wave to attainment of a reflected wave, the die length (it is equivalent to HS of drawing 1) of the path of an acoustic wave is calculated, further, flow Q is calculated based on the tap holes [each / 15a-15d] depth of water H and each tap holes [15a-15d] opening area, and this is recorded or displayed.

[0025] Supposing change arises in an impregnation flow rate or an outflow discharge and the height of the water surface 22 has increase and decrease at this time, water will move along with a spiral in the inside of the spiral-like acoustic wave tubing 17. Since the movement magnitude of the water in this case becomes what was expanded from the variation of vertical water level as shown in (b) of drawing 2 , that movement magnitude or the amount of increase and decrease of the die length of an acoustic wave path can be expanded and measured with a fixed dilation ratio.

[0026] On the other hand, the depth of water H of tap hole 15a and the relation of flow Q are the curve L1 shown in drawing 4 . It is shown.

[0027] When water level goes up and it comes to flow out of the 2nd step of tap hole 15b, it is a curve L2 to this. It is a curve L3 and L4 as the tap holes 15c and 15d of an upper case are henceforth reached in weight. It becomes in heaviness.

[0028] The above-mentioned curve L1 Since change of a flow will decrease if depth of water H becomes size for it to be only tap hole 15a of the lowest edge so that it may be shown, it is hard to catch the change. However, if two or more steps of tap holes 15a-15d are formed, the relation between depth of water H and a flow Q will approach proportionality as a whole so that it may understand by the ream of the continuous-line part of each curve. For this reason, it becomes easy to catch change of a flow.

[0029] Although the above example described the flowmeter, if this flowmeter also has in coincidence the function as a water gauge to detect the height of the water surface 22 and the result of an operation of depth of water H is taken out in a metering device 21 to it, it will turn into a water gauge.

[0030]

[Problem(s) to be Solved by the Invention] As mentioned above, also in invention [which / of a flowmeter and a water gauge], since change of water level is expanded by having used the spiral-like

thing as acoustic wave tubing, even if it does not make fine the pulse separation (measurement graduation) of a measuring device, it is effective in water level and the detection precision of a flow rate improving.

[0031] Moreover, in the above-mentioned flowmeter, it is effective in the ability to detect change of a flow rate much more correctly by preparing two or more steps of tap holes.
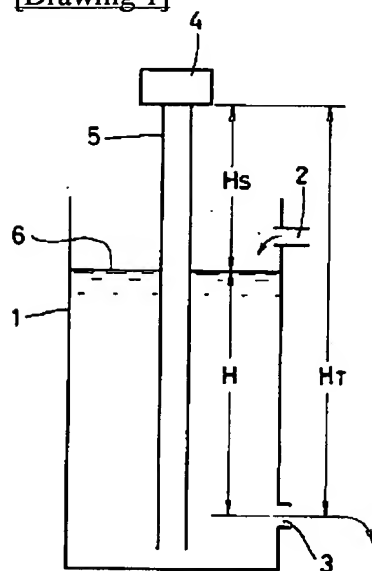

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] A flow rate and the detection principle Fig. of water level
[Drawing 2] (a), (b): The explanatory view of expansion of at least water with spiral acoustic wave tubing
[Drawing 3] The sectional view of the example of a flowmeter
[Drawing 4] The related Fig. of depth of water and a flow rate
[Description of Notations]
10 Pedestal
11 Contents Machine
12 Outer Container
13 Acoustic Wave Transducer
14 Hose
15 A-15D Tap Hole
16 16' Exhaust port
17 Spiral-like Acoustic Wave Tubing
18 Retaining Ring
19 Hole
20 Strainer
21 Metering Device
22 Water Surface

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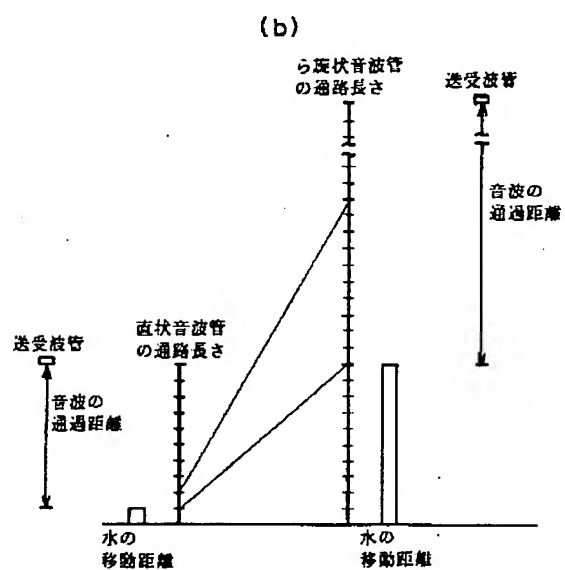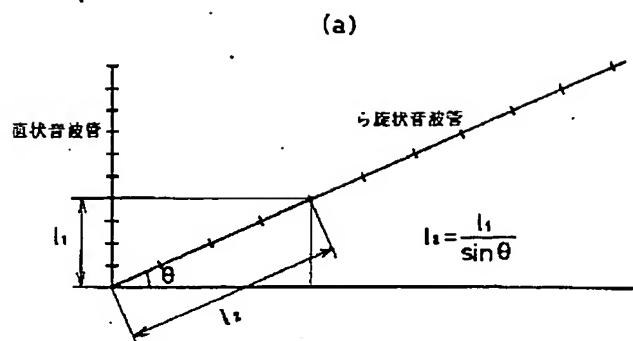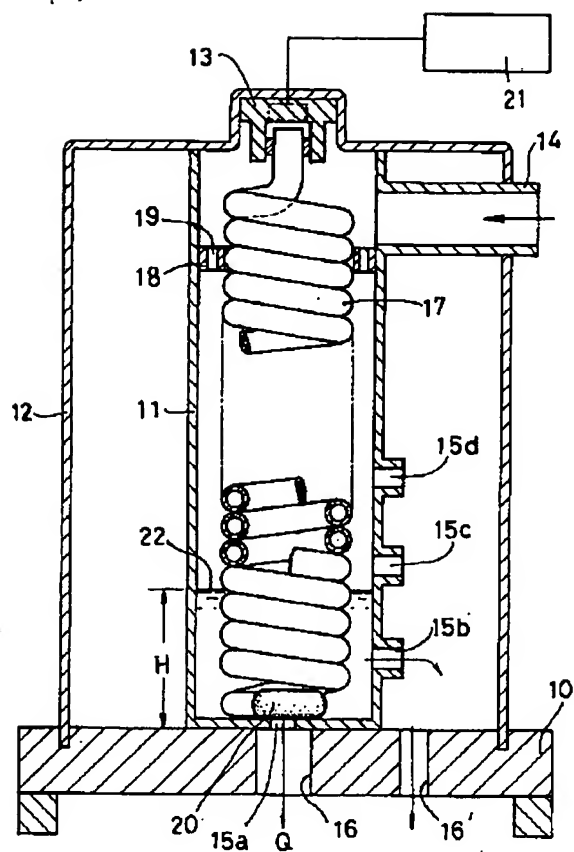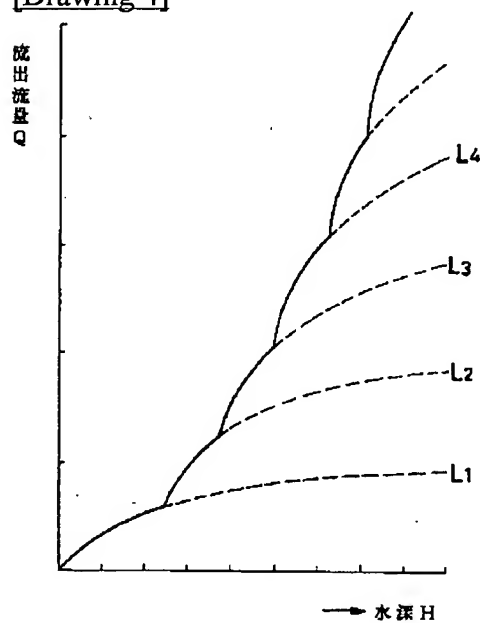3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]

[Drawing 2]

(a)

直状音波管　　　　　　ら旋状音波管

$$l_2 = \frac{l_1}{\sin\theta}$$

(b)

ら旋状音波管
の通路長さ

送受波器

音波の
通過距離

送受波器

直状音波管
の通路長さ

音波の
通過距離

水の
移動距離

水の
移動距離

[Drawing 3]

[Drawing 4]

[Translation done.]